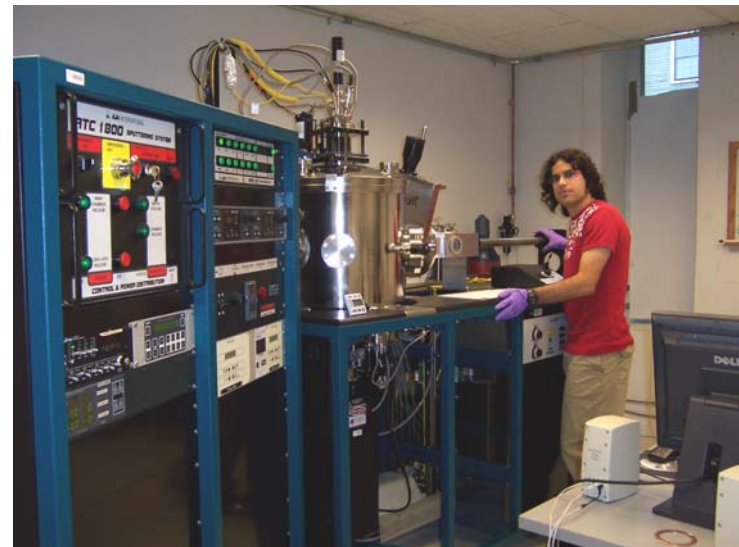


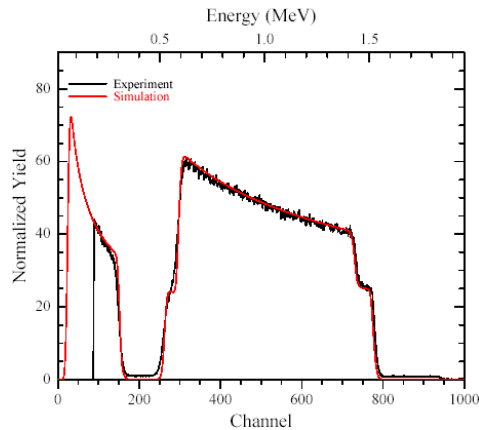
A confocal sputter deposition system with in-situ stress gauge for thin-film research and education

A tool for the deposition of thin film alloys and multilayers: This tool is designed specifically for the deposition of alloy coatings that require a high degree of composition control. This is of paramount importance when growing coatings of functional materials such as NiTi shape memory alloys or ferromagnetic Fe_3Pd , where equilibrium phases and transformation temperatures vary greatly with small shifts in composition. The system has an integrated stress gauge that makes it possible to monitor film stress in-situ during film growth and during heat treatments. The availability of this deposition system has made a great impact on educational programs at Harvard: The system is heavily used by undergraduates for independent research projects and laboratory sessions.

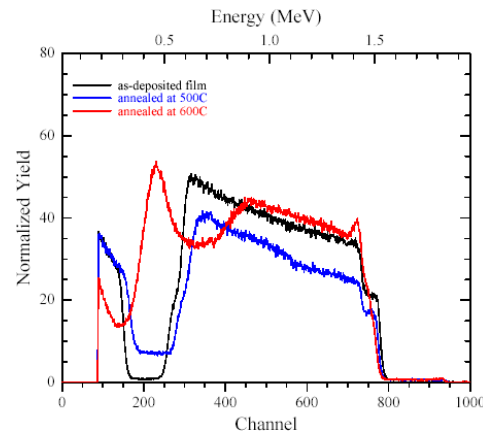
Undergraduate student Tzahi Cohen loading a substrate in the system for the deposition of a ferromagnetic shape memory coating. The UHV chamber is visible in the center of the photograph. The integrated stress sensor can be seen immediately below it.



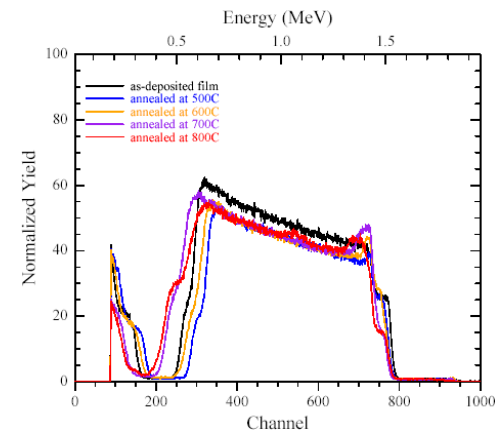
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(a) As deposited NiTi on Si

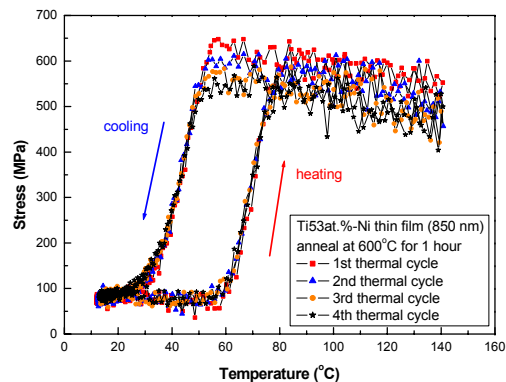


(b) Annealed NiTi on Si



(c) Annealed NiTi on SiN_x barrier

RBS spectra illustrating the chemical reaction of a NiTi shape memory coating with the underlying Si substrate after high temperature anneals (REU project – Ann Lai).



Stress-temperature hysteresis curves illustrating the shape memory effect in a 850 nm NiTi film. The graph shows how enormous stress changes can happen over a temperature range of just a few degrees. This effect can be used to actuate mechanical devices on the micro-scale (Undergraduate laboratory sessions ES 190).